

the inductors have inductance values are on the order of microHenries. The respective inductors, **104**, **108**, preferably reside in electronic apparatus having additional functionality. For example, the transmitter may reside within a battery charger or power inverter apparatus **107**. The receiver may reside in a communication, computer, imaging or other device **109**, to cite a few examples. The respective inductors **104**, **108**, are placed within their respective apparatus such that they may be placed in physical proximity for inductive coupling during operation such that the inductors are in communication with one another for the exchange of power and/or data. The system **100** drives the inductors on one side (VACT1 and VACT2) and receives on the other side (VACR1 and VACR2). Such systems can be utilized for high bandwidth data transmission as well as power transfer across the inductive coupling (**104**, **108**). The receiver **106** preferably includes an error detection mechanism **110** whereby the presence of errors in the received data signal may be identified. Upon detection of data errors, the system is adapted to implement one or more error correction algorithms designed to enhance data reception and/or transmission.

[0021] The placement of a resistor or other impedance element between the AC inputs of the receiver can be used to tune the frequency response and can eliminate ringing at the receiver terminals, as shown at R. The selection of a suitable resistor value attenuates or eliminates the ringing that otherwise would result from system parasitics. Too large a resistance value does not sufficiently dampen the ringing. Too small a resistance value interferes with the data signal. The peaking at high frequency causes ringing in the transient signal and can cause data errors if not managed properly. An extension of this basic principle uses an adjustable resistor such as a digitally controlled resistor or RDAC. Using an adjustable resistor allows the system to respond to changing environmental conditions, such as changes in temperature and changes in coil alignment. In any configuration, the system can be tuned automatically for improved system performance. This can result in fewer bit errors or higher transmission frequencies. This tuning can be done once at system startup, or periodically during normal operation, or in response to operational parameters. If the received data stream is oversampled, the oversampled data may be used to evaluate signal integrity. Thus, the adjustable resistor can be tuned during data transmission to improve the signal integrity and maintain an acceptable error rate and/or preferred transmission frequency.

[0022] In operation, the system **100** input is preferably returned to a known default value during periods when data is not being transmitted. To achieve this, the receiver inputs are preferably biased to drift to a known state when not being driven. An alternative is to implement the resistor R between the receiver terminals using two adjustable resistors, which may be used to set the appropriate bias levels. The adjustable resistors provide damping for improving signal integrity and also provide a known bias to the system during undriven states. Another benefit of using an adjustable resistor configuration is that it allows for the use of multiple transmission frequencies. Ringing in the system is highly dependent on the system parameters such as parasitic capacitance and resistance as well as coil inductance. These parameters can be functions of the excitation frequency and vary as the frequency changes. Therefore, the system can exhibit different

behavior at different transmission frequencies and may be dynamically adjusted for improved operation at any given frequency.

[0023] There are additional advantages to utilizing inductive data transmission and inductive power transmission simultaneously. In a system transmitting both power and data, the power loop can be regulated using communication through the inductive data path. This path has much higher bandwidth than other communication techniques such as modulating the power signal. Providing a high speed data path also enables additional functionality. Using the high speed data path for power control permits higher bandwidth in the power system and faster response times. In many systems, such as power converters and battery chargers, a separate charger IC or other voltage regulator on the secondary side may be used to control the secondary side voltage. Use of a high bandwidth feedback loop eliminates the need for the additional regulator on the secondary side. Voltage and/or current control can be achieved using the power loop with high bandwidth control through the coupled inductor data link. In many systems, the secondary side may advantageously have additional protection features built in to protect the secondary side circuits from over-voltage conditions. Preferably, if response times are fast, additional protection circuits on the secondary side may be unnecessary, reducing system cost and area.

[0024] Transmission of power and data simultaneously may potentially result in interference between the two paths. This has the potential to cause bad or missing bits in the data stream. In order to avoid this problem, the data and power signals may be alternated. Using this method, the power signal is periodically stopped. During this dead time in the power transmission, bursts of high frequency data are sent. Since the data bandwidth is very high, significant amounts of data can be transmitted even in a short window of time.

[0025] Sending and receiving data within the coupled inductor data transfer system may include the use of digital encoding and may be performed with a defined protocol or with a unique protocol determined for a particular application. Various techniques may also be employed for assuring data reliability and integrity. Oversampling of the received data may be performed to increase the reliability of the data. If the recovered oversampled data indicates that reliability is decreasing, the system is preferably adapted to take one or more dynamic steps to increase reliability of the recovered data. Preferably, the oversampling window may be shifted in either direction, either to the left or to the right of the current oversampling window. Alternatively, or additionally, the oversampling window size may be changed, either decreasing or increasing the window until an improvement is detected. In another available step, a change may be made in the number of sampling points used to determine the recovered data value, either decreasing or increasing the number of sampling points. Various functions may be used to seek the optimum sample, such as a simple Boolean function or a suitable more sophisticated algorithm.

[0026] FIG. 2 is a diagram of an algorithm **200** for preserving data integrity in accordance with an exemplary embodiment of the invention. The algorithm **200** may be implemented using a computer, signal processing platform, or other programmable device. Data is transmitted **202** by a suitable transmitter and is received as a data signal for processing **204**. In an error detection step **206**, the data signal is checked for the presence of errors. Error checking may include techniques